Nov. 19, 1935. F. H. MANCHESTER 2,021,371

ARTICLE OF MANUFACTURE AND PREPARATION THEREOF

Filed Feb. 14, 1935

Fig. 3

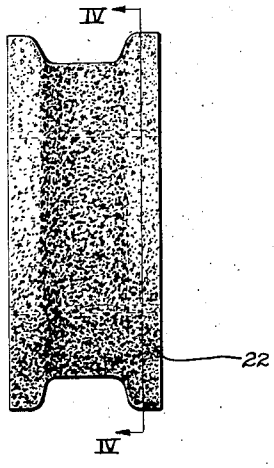


Fig 4

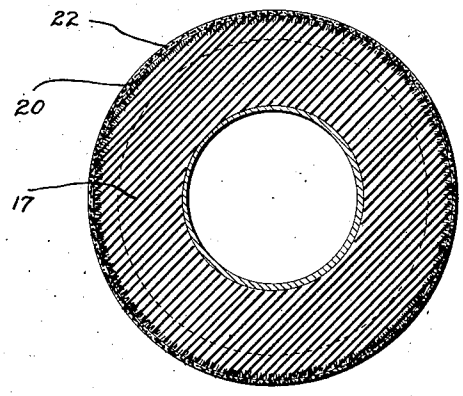


Fig. 1

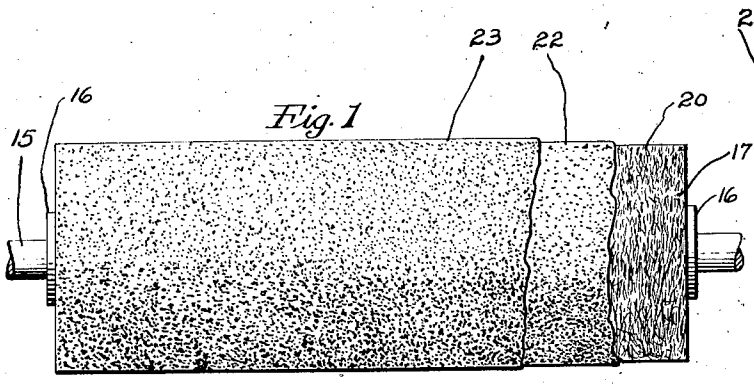
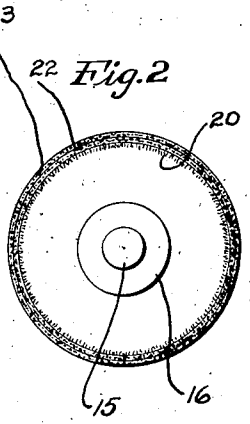


Fig. 2



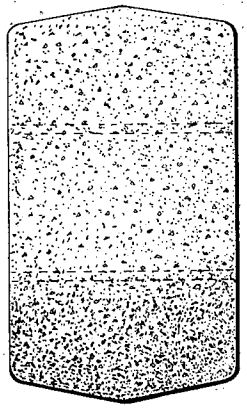
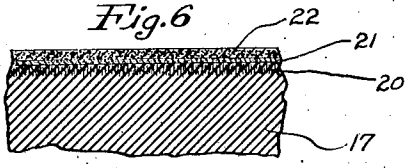


Fig. 5

Fig. 6



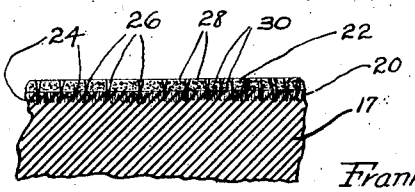


Fig. 7

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UNITED STATES PATENT OFFICE

2,021,371

ARTICLE OF MANUFACTURE AND PREPARATION THEREOF

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Application February 14, 1935, Serial No. 6,511

12 Claims. (Cl. 51—190)

This invention relates to improved articles of manufacture and particularly to surfacing apparatus, such as rolls, wheels, face grinders and belts, adapted for abrading and polishing, and to the method of preparing such improved articles of manufacture. It especially concerns surfacing devices in which the abrading or polishing surfaces are supported upon resilient rubber cushion or bases.

An object of the invention is to provide an improved article of manufacture comprising rubber and subdivided material attached thereto. Another is to provide a surfacing element which is efficent, long-wearing and inexpensive. Still another object is to provide an improved bond between the resilient rubber cushion and the abrasive layer of a surfacing element—particularly, in devices in which the abrasive layer is substantially inelastic. A further object is to provide a cushioned polishing device which may have either a convex or concave surface and still be efficient and long-wearing. It is a still further object of the invention to provide a polishing roll or wheel having a substantially uniformly true body of resilient rubber about the roll or wheel axle and to the surface of which a number of applications of glue and abrasive may be firmly adhered from time to time without adversely affecting the resilient rubber body. Another object is to provide a method of preparing the improved articles of manufacture of the invention. Other objects and advantages will become apparent as the description of the invention proceeds.

Cushioned surfacing elements have been known heretofore. For instance, wheels with cloth or felt cushions have been used extensively. Those with cloth cushions polish neither as swiftly nor as efficiently as those with rubber cushions while those with felt are more expensive than those with rubber. In the field of rubber cushioned wheels and rolls one difficulty has been that of satisfactorily bonding the abrasive material to the rubber. The abrasive material is most generally attached to the wheel or roll by means of glue or other inelastic protein adhesive. Glue, however, as well as other such adhesives, does not adhere directly to rubber successfully, especially when the rubber is deformed, but spalls or chips off after a short period of use.

One improvement in rubber surfacing elements which has been fairly satisfactory is that described in United States Patent No. 1,963,357 to E. A. Filley. Therein one or more layers of fabric are secured to the rubber body and the abrasive material is bonded to the fabric. Another improvement is that described in my application Serial No. 700,832, filed December 4, 1933, wherein is set forth an abrasive device comprising rubber to which the abrasive and glue layer is bonded by a protein-latex composition.

While these referred-to improvements are in general satisfactory, this invention comprises a discovery which is even more satisfactory. Briefly stated, it involves an improved resilient rubber-subdivided material composite article in which the subdivided material is more firmly bonded to the resilient rubber than has been possible heretofore. It is of particular value where the layer of subdivided material is substantially inelastic. As applied to a surfacing element, it comprises the provision between the body of resilient rubber and abrasive material of a layer which is substantially inelastic and contains an irregular patch work of very small fissures. For a better understanding of the invention, reference may be had to the accompanying drawing wherein:

Fig. 1 is a side elevational view of a polishing roll embodying the features of the invention in which various layers are broken away to more clearly illustrate the construction;

Fig. 2 is an end elevational view of the roll of Fig. 1;

Fig. 3 is an elevation of a polishing wheel embodying the features of the invention and showing one form of a wheel which the invention makes possible;

Fig. 4 is a cross-sectional view of the wheel shown in Fig. 3 taken along the line IV—IV;

Fig. 5 is an end elevational view of a polishing wheel with a differently shaped surface from that shown in Fig. 3;

Fig. 6 is an enlarged, fragmentary view showing the features of the invention as well as an alternative feature which may be embodied therein; and

Fig. 7 is a more enlarged, fragmentary view than Fig. 6 showing more clearly the features of the invention.

The principles of the present invention are applicable particularly to rubber cushioned polishing wheels and rolls but extend to other rubber cushioned surfacing elements such as, for example, belts and face grinders and also to any article of manufacture comprising resilient rubber to which is attached an inelastic layer of subdivided material. One type illustrated in Figs. 1 and 2 is a roll adapted for polishing or grinding surfaces of considerable area. In this embodiment, the polishing roll may be of considerable

length, varying from six inches to six feet, or more, depending upon the use to which it is put. The diameter of the roll also may be widely varied, depending also upon the use for which it is designed.

In the roll shown in Figs. 1 and 2 there is comprised a shaft 15 and flanges or end plates 16 which may be secured to the shaft 15 or may be formed integrally therewith. Between the flanges 16 and encircling and secured to the shaft 15 by a hard rubber layer or other attaching means well known in the art is a body of resilient rubber 17 forming a cushion. It will be appreciated that the composition and resiliency of the rubber body 17 is dependent upon the grinding operation to be performed and may be of any degree of softness or stiffness which functions best in the adaptation to which the wheel is put. It will also be understood that while the word "rubber" applies preferably to the ordinary form derived from the Hevea Brasiliensis tree, including, of course, the usual compounding ingredients, it also comprises synthetic vulcanizable resilient materials, generally termed synthetic rubber, of which Du Prene is an example.

On the outside of the body of resilient rubber 17 is a thin layer 20, preferably of treated rubber, which is substantially inelastic, firmly adherent to the rubber body 17 and which comprises an irregular patch work of very small fissures. To the layer 20 is then bonded abrasive material 22 by means of an adhesive such as glue. If desired, any number of additional coatings of abrasive material indicated by the numeral 23 may be applied. The abrasive material may be applied in any known manner. One method is to apply a mixture of glue or other adhesive and a suitable granular abrasive material, exemplary of the latter being sand, emery, carborundum, rouge, etc. The abrasive material may also be applied by coating layer 20 with glue or other adhesive and then, while the adhesive is still tacky, sprinkling thereover the abrasive material, or by rolling the device in a loose quantity of abrasive.

In the manufacture of a polishing roll embodying the invention a vulcanizable resilient rubber body 17 is attached to the shaft 15 by means of a layer of hard rubber or other bonding agent, such as a suitable cement, between the two. The roll is then vulcanized and the periphery of the rubber layer 17 ground to a state of smoothness and substantially uniform trueness. Thereupon the layer 20 is provided. It is preferably obtained by treating the outer surface of the rubber layer 17 in such a manner that the surface becomes substantially inelastic and crackable on deformation, thereupon giving an irregular patch work of very small fissures. For treating the surface of the resilient rubber 17 to produce this desired effect several agents have been found satisfactory, as will be more fully described hereafter. Also, in the use of these agents certain steps hereafter described are required for best results.

One method of preparing layer 20 is that of rotating the roll at room temperature in a bath of concentrated sulphuric acid (98%) for a short period of time. The time required is that sufficient to produce the effect described and varies with the type of rubber compound comprising the resilient rubber body 17 and with the strength of acid used. For instance, with a highly loaded carbon black rubber stock the application of 98% sulphuric acid requires only ½ minute to transform the surface thereof to a hardened substantially inelastic layer which cracks on deformation to give an irregular patchwork of very small fissures. With a soft, nearly pure gum stock on the other hand, an application of the same acid for approximately three minutes is required to give the desired surface layer 20. Similarly, the time required varies with the concentration of the acid. Thus, with a highly loaded black stock the following times of reaction are required to produce the same effect:

Concentration of H_2SO_4	Time
Per cent	*Minutes*
93	½
90	1
80	3
70	4

It will also be understood that the reaction should be stopped as soon as a good "crust" (the layer 20) is obtained, for further treatment chars and weakens the hardened layer making it somewhat friable or crumbly and not sufficiently adherent to the unconverted rubber underneath. At the completion of the treatment the acid is drained off and the roll washed thoroughly with water and allowed to dry. It will be found that the surface 20 is firmly adherent to the rubber body 17, and has been transformed from its original resilient state to a substantially inelastic layer which on deformation, either by compression or tension, cracks, giving an irregular patchwork of thin fissures. Thereafter, the abrasive layers 22 and 23 may be applied as previously described.

The invention is further illustrated by Fig. 7, an enlarged fragmentary cross-sectional view of a surface device embodying the invention. Here 17 represents the resilient rubber body, 20 the substantially inelastic and fissured layer, and 22 the layer of abrasive and bonding agent. The fissures in the layer 20 are shown by the numeral 24 and are formed substantially immediately upon deformation of the layer 20. If the bonding agent for the abrasive is glue or other non-extensible adhesive, on deformation of the resilient body 17, the layer 22 will also crack as denoted by the numeral 26. If there is no alleviating means such as is provided by the layer 20, the abrasive layer 28 will become loosened at the edges of the fissures 26 from the resilient body 17 and will soon chip off in flakes from said body 17. As noted in Fig. 7, the layer 22 will crack or "check" at substantially the same places as the layer 20, forming small sections of abrasive material 28 on top of small sections 30 of the layer 20 which may be said to be in the nature of islands. The layer 20 while integrally adherent to the rubber body 17, yet, by being fissured, permits a relatively large amount of movement of the small "islands" 28. The abrasive "islands" 28 adhere firmly to the "islands" 30 and, on deflection, such as is caused by the application of the surfacing device to some metal article which is being polished, both "islands" 28 and 30 move as one body, thereby preventing the chipping off from the resilient rubber 17 of the abrasive layer 22 at the fissures 26. It is readily seen that an excellent bonding between the rubber body 17 and the abrasive layer 22 is provided. It is to be understood that this invention is not limited by any theories expressed herein but that, in any event, the abrasive layer

22, although it becomes cracked extensively throughout its area immediately upon use of the polishing device, still it remains firmly adherent at the cracked edges and, in fact, throughout its area.

The layer 20 may be prepared by means of other treating agents than sulphuric acid. For example, it has been found satisfactory to rotate or immerse (preferably immerse because the tin tetra chloride loses strength rapidly by picking up moisture from the air) the roll or other polishing device at room temperature in a bath of a 2% solution of tin tetra chloride in ethylene dichloride or other solvent for a short period of time. With a highly loaded black stock a treatment of three or four minutes is sufficient. The tin tetra chloride also renders the surface inelastic and crackable on deformation and, in fact, gives a thicker, tougher layer than sulphuric acid without rendering the layer friable. It, however, gives a rather glossy surface to which the abrasive bonding agent adheres satisfactory but not quite as strongly as to a sulphuric acid treated surface. It has the advantage though of providing a somewhat stronger union between the treated layer 20 and the resilient rubber body 17.

For a layer 20 prepared by the use of tin tetra chloride the modification shown in Fig. 6 has been found desirable, although not necessary. Fig. 6 also shows an enlarged, fragmentary, cross-sectional view of a surfacing device embodying the invention. In this figure the numeral 17 denotes the resilient rubber cushion and 20 the treated surface of the rubber cushion 17. Covering the treated surface layer 20 is a coating of a protein-latex adhesive which will firmly adhere to the surface layer 20 and to which the glue-abrasive layer will firmly adhere. This adhesive coating 21 may comprise an aqueous composition comprising, for example, 5% of casein and 15% of latex, casein being in solution as ammonium caseinate. The reference to latex content refers to the rubber hydrocarbon present in the latex. If desired, several coatings of this casein-latex composition may be applied to the layer 20. Also, the casein and latex may be varied in any suitable proportions, compositions comprising 5% casein and 2½% latex as well as compositions comprising 30% casein and 5% latex having been found satisfactory. It is also possible to use other proteins such as haemoglobin, glue, mucin, etc. A vulcanized latex may also be employed in the compositions disclosed herein or a small amount of sulphur may be added and the composition vulcanized. However, unvulcanized latex without sulphur is quite satisfactory. After the one or more adhesive layers 21 is substantially dry, a coating of glue or other adhesive and an abrasive 22 may be applied as described with reference to Fig. 1.

Another method of treatment found quite satisfactory is that of first treating the surface of the rubber body 17 with sulphuric acid for a short period (with concentrated H_2SO_4 and a highly loaded black stock one minute is sufficient) and thereafter treating it with a two percent solution of tin tetra chloride in ethylene dichloride for four minutes. Such a treatment provides a layer 20 to which the glue-abrasive layer 22 will adhere very strongly and which is a tough, deeply reacted, foundation layer firmly bound to the rubber body 17.

Other agents for providing the layer 20 are a 5% solution of bromine (Br_2) in ethylene dichloride or other solvent which requires a ½ minute treatment on a highly loaded black stock to give the desired layer 20. A one percent solution of bromine (Br_2) in ethylene dichloride is also satisfactory, requiring about one minute on a highly loaded black stock to give the desired effect. Saturated chlorine in water is also a good treating agent but requires a period of approximately four hours to provide the proper layer 20. Nitric acid also can be used, a concentrated (70%) nitric acid solution requiring five minutes' treatment. Other treating agents are 50% CrO_3 in water at temperatures up to boiling, mixtures of nitric acid and sulphuric acids, a sulphuric acid containing CrO_3, hydrochloric acid containing an oxidizing agent such as CrO_3, $K_2Cr_2O_4$, $KMnO_4$, and chromyl chloride (CrO_2Cl_2) in solution in a solvent such carbon disulphide, carbon tetra chloride, ethylene dibromide, ethylene dichloride, amylene dichloride and acetylene tetra chloride.

Further illustrative of the invention are the polishing wheels shown in Figs. 3, 4 and 5. Such wheels are of the type employed in high speed polishing articles such as automobile bumpers and the like. Fig. 3 illustrates a wheel with a concave surface and Fig. 5 another wheel with a convex surface, both of these shapes being made possible in a satisfactory form for the first time by the present invention. The wheels of Figs. 3 and 5 may comprise a shaft such as that described in Fig. 1 or they may comprise a wheel with the surfacing element in the form of a thin ring in the manner described in United States Patent No. 1,963,357.

Fig. 4 is a cross-section of the wheel of Fig. 3 taken along the line IV—IV and shows the body of resilient rubber 17, the treated layer 20 and the adhesive-abrasive layer 22.

The invention is particularly desirable in polishing rolls or wheels which are used for fast, uniform polishing. As set forth hereinbefore, the glue and abrasive layer adheres firmly to the layer 20, and, although cracked or "checked" throughout its area, remains attached to the surfacing device for a much longer period of time than has been possible by prior art devices. Another advantage of the invention is that the layer 20 will withstand the heating caused by the friction of cutting and polishing metal articles. Still another advantage is found in the simple method provided for preparing such surfacing elements. As has been disclosed, the process simply comprises the attachment of a resilient rubber body to a shaft or other base, grinding the periphery of the rubber layer to trueness (desirable where the wheel or roll must undergo high speed operations) immersing or rotating the rubber body in a treating bath for a short period of time and then applying the abrasive.

The invention is furthermore particularly applicable for wheels and rolls in which the abrasive is bonded by means of glue, the glue being water soluble and the treated layer 20 not being affected by water. The abrasive layer when worn down may be replaced merely by dissolving off the glue and abrasive in water and then re-coating the layer 20 with more glue and abrasive. This process may be repeated from six to twenty times without the necessity for regrinding the roll or wheel and re-dipping it in a treating bath.

Another advantage of the invention is found in the fact that surfacing elements with either convex or concave surfaces may be prepared simply and efficiently. Furthermore, wheels or rolls with such surfaces are quite efficient and long wearing. The invention is also applicable for use in rubber rings or sleeves containing no

base. The resilient rubber body may be provided with a layer 20 as provided herein and then secured to a shaft, wheel or other base by suitable means. Also, if desired, one or more abrasive layers 22 may be applied prior to securing the rubber to a base. The invention further may be employed to advantage in face grinders which are to be used for polishing articles of glass and the like. It may be employed generally in attaching inelastic subdivided material to a resilient rubber body.

It will be understood that the fineness or coarseness of the abrasive applied to the surfacing elements of the invention is dependent upon the type of work for which they are intended, and that the number of coatings of abrasive upon the layer 20 may be widely varied to meet different requirements. Accordingly, the terms "abrasive", "polishing", etc. in the claims are to be construed in their broadest sense. It will also be understood that as an adhesive for the abrasive or other subdivided material, in addition to glue or other proteinous material, bakelite and other thermosetting synthetic resins may be employed. Thermoplastic resins likewise may be used but they should have a melting point sufficiently high to prevent softening during use. Sodium silicate also is a very satisfactory substitute for glue.

Although only the preferred forms which the invention may assume have been illustrated and described in detail, it will be apparent to those skilled in the art that the invention is not so limited, but that various modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims. It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty reside in the invention.

What I claim is:

1. An improved polishing device comprising a base member, a body of resilient rubber secured to said base member, a thin layer of treated rubber comprising the outer portion of said body of resilient rubber, said layer of treated rubber being difficultly separable from said body of resilient rubber, being substantially inelastic and containing an irregular patchwork of very small fissures, and a coating of adhesive and abrasive secured to said layer.

2. In a rubber cushioning surfacing element which comprises a base, a cushioning layer of resilient rubber and an outer layer of adhesive and abrasive material, the improvement which comprises a layer of treated rubber between the resilient rubber cushion and the layer of adhesive and abrasive, said layer of treated rubber being integrally adherent to the body of resilient rubber, being substantially inelastic and containing an irregular patchwork of fissures.

3. The method of preparing an improved surfacing element which comprises attaching a resilient, vulcanized rubber body to a base, rendering the surface of said resilient rubber body substantially inelastic and crackable on deformation by subjecting the surface for a short period of time to the action of a rubber conversion agent, arresting the action of the conversion agent and bonding abrasive material to said surface.

4. The method of preparing an improved surfacing element which comprises vulcanizing a resilient rubber body to a base, rendering the surface on said resilient rubber body substantially inelastic and crackable on deformation by subjecting the surface for a short period of time to the action of sulphuric acid, arresting the action of the sulphuric acid and bonding abrasive material to said surface.

5. An improved process for preparing a cylindrical polishing element which comprises vulcanizing a circular body of resilient rubber to a base, grinding the periphery of the resilient rubber to substantial smoothness and trueness, subjecting the surface of said body of resilient rubber to a rubber conversion agent for a time sufficient to convert the surface of said body of resilient rubber to a substantially inelastic layer which is crackable on deformation but insufficient to convert said surface to a friable layer, and bonding abrasive material to said treated surface.

6. An improved polishing device comprising a base member, a body of resilient rubber secured to said base member, a thin layer of treated rubber comprising the outer portion of said body of resilient rubber, said layer of treated rubber being difficultly separable from said body of resilient rubber, being substantially inelastic and containing an irregular patchwork of very small fissures, a coating of a protein-latex composition and a coating of adhesive and abrasive secured to said layer.

7. An improved polishing device comprising a base member, a body of resilient rubber secured to said base member, a thin layer of treated rubber comprising the outer portion of said body of resilient rubber, said layer of treated rubber being difficultly separable from said body of resilient rubber, being substantially inelastic and containing an irregular patchwork of very small fissures, a coating of a casein-latex composition and a coating of glue and abrasive secured to said layer.

8. In the method of preparing improved rubber cushioned polishing devices, the step which comprises subjecting the surface of the resilient rubber cushion to a rubber conversion agent for a time sufficient to convert an outer layer of said resilient rubber cushion to a substantially inelastic layer which is crackable on deformation but insufficient to convert said surface to a friable layer.

9. In the method of preparing improved rubber cushioned polishing devices, the step which comprises subjecting a surface of the resilient rubber cushion to a rubber conversion agent for a time sufficient to convert an outer layer of said resilient rubber cushion to a substantially inelastic layer which is crackable on deformation but insufficient to convert said surface to a friable layer, said rubber conversion agent being selected from the group consisting of sulphuric acid, tin tetra chloride, bromine, chlorine, nitric acid, a mixture of nitric and sulphuric acids, sulphuric acid containing CrO_3, and hydrochloric acid containing an oxidizing agent.

10. An improved polishing device comprising a body of resilient rubber, a thin layer of treated rubber comprising an outer portion of said body of resilient rubber, said layer of treated rubber being difficultly separable from said body of resilient rubber, being substantially inelastic and containing an irregular patchwork of very small fissures and a coating of adhesive and abrasive secured to said layer.

11. An improved polishing device comprising a base member, a body of resilient rubber secured to said base member, a relatively thin outer layer of chemically treated rubber integral with said

body of resilient rubber, said outer layer being substantially inelastic and crackable on deformation so that fissures are formed in the surface thereof and a coating of adhesive and abrasive applied to the outer surface of said layer.

12. An improved polishing device comprising a base member, a body of resilient rubber secured to said base member, a thin layer of treated rubber comprising the outer portion of said body of resilient rubber, said layer of treated rubber being difficultly separable from said body of resilient rubber, being substantially inelastic and containing an irregular patchwork of very small fissures, and a coating of finely divided material secured to said layer.

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